

## Evaluation of Insulin and Lipid Parameters in Type 2 Diabetics

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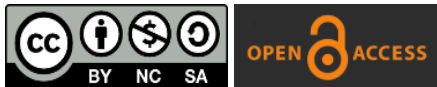
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### Abstract

**Introduction:** Type 2 diabetes is a multifactorial disease whose hyperglycemia is linked to a reduction in insulin secretion and insulin sensitivity, combined with lipid metabolism disorders. Management of the disease requires not only exploration of carbohydrate metabolism, but also measurement of certain lipid parameters. **Materials and Methods:** This study was carried out in 100 patients with type 2 diabetes. In these patients, venous blood samples were taken after a minimum 12 hours fast. Parameters such as insulin, fasting blood glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides (TG) were measured using the ARCHITECT plus Ci4100 automated system. **Results:** The mean age of patients was  $55.1 \pm 12.1$  years; 43 patients were aged under 55 and 57 patients were aged 55 or over, respectively 43.% and 57%. We noted 61 women and 39 men, or 61% and 39% respectively, with a sex ratio 0.63. The results also showed that 75% of patients had an insulin level  $< 11 \text{ mUI/l}$  and 25% a level  $\geq 11 \text{ mUI/l}$ . Some of the patients had total hypercholesterolemia, hyperLDLaemia, hypoHDLaemia, hypertriglyceridemia with percentages of 90, 67, 95 and 22 respectively. A statistically significant negative correlation between insulin and blood glucose was found ( $p\text{-value} < 0.05$ ). On the other hand, the correlation between insulin and lipid parameters was not statistically significant. **Conclusion:** Our study shows that insulin resistance plays an important role in the pathophysiology of dyslipidemia in type 2 diabetes.

**Keywords:** Insulin and Type 2 diabetes.

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## 1. Introduction

Lipid abnormalities are frequent and particular in type 2 diabetic patients [1]. Indeed, diabetic patients are immediately considered to be at high cardiovascular risk, and dyslipidemia is one of the main risk factors for this disease [2] dyslipidemia plays an important role in mortality, hence the importance of treating it and managing other associated cardiovascular risk factors [3].

Type 2 diabetes in its "common" form is a multifactorial disease. Hyperglycemia is due to reduced glucose uptake and excessive hepatic glucose production, linked to reduced insulin secretion and insulin sensitivity [4]. Insulin disorders (insulin resistance and "relative" insulin deficiency) appear to play a major role in changes in lipid metabolism. The abnormalities observed are both quantitative and qualitative [5].

From a quantitative point of view, in type 2 diabetes, we often find an increase in triglycerides accompanied by a decrease in HDL cholesterol, without frank total hypercholesterolemia. Qualitative abnormalities generally affect large VLDL. LDL and HDL are enriched in triglycerides, and LDL also undergoes oxidation. In this specific case of diabetes, glycation of apolipoproteins contributes to the qualitative change in lipoproteins [6]. In view of this disturbance in lipid metabolism, we felt it necessary to carry out this study, the general aim of which was to evaluate insulin concentrations, fasting glycemia, total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides in type 2 diabetics.

## 2. Methodology

This is a prospective study of 100 type 2 diabetics. In these patients, venous blood samples were taken after a minimum 12 hours fast. Parameters such as insulin, fasting blood glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides were measured using the ARCHITECT plus Ci4100 automated system.

The reference values retained for these parameters are for insulin < 11mUI/l; fasting blood glucose 0.70 to 1.10 g/l, total cholesterol 1.2 to 2 g/l; HDL-cholesterol > 0.4g/l; LDL-cholesterol < 1.3 g/l; and triglycerides 0.4 to 1.2 g/l. A computer database was created using Microsoft Office 2016 Excel software from patient records. Statistical analysis was performed using R studio 4.1.2 software. For qualitative variables, results were expressed as headcounts and percentages, and for quantitative variables, results were expressed as means plus or minus standard deviation or according to distribution. Results are considered statistically significant if the p coefficient is less than 0.05. The PEARSON R is used to study correlations.

## 3. Results

The mean age of the population was  $55.1 \pm 12.1$ ; 43 patients were aged under 55 and 57 patients were aged 55 or over, or 43% and 57% respectively. Out of a total of 100 patients, we have 61 women and 39 men or 61% and 39% respectively, with a sex ratio of 0.63.

Table I shows the characteristics of the parameters.

**Table I:** Means and Standard Deviations of Biological Parameters.

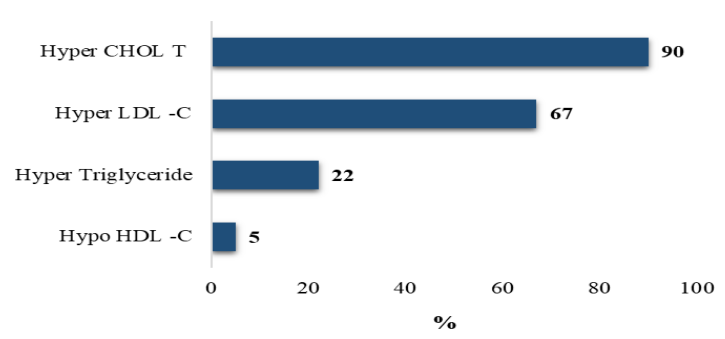
Parameters	Mean ± standard deviation	Reference values
<b>INSULIN (mUI/ l)</b>	8,0 ± 5,2	<11
<b>GLYCEMIA (g/l)</b>	1,7 ± 0,9	fasting blood glucose: Adult: 0.70 - 1.1 Children: 0.5 to 1.1
<b>LDL-cholesterol (g/l)</b>	8,0 ± 5,2	<1,6
<b>Triglycerides (g/l)</b>	1,4 ± 0,4	<1,5
<b>Total Cholesterol (g/l)</b>	1,4 ± 0,4	<2
<b>HDL- cholesterol (g/l)</b>	2,7 ± 0,6	> 0,4

In our study 75% have an insulin level < 11mUI/l and 25% a level ≥ 11 mUI/l.

**Table 2:** Population Distribution by Insulin Class.

Insulin class	Percentage (%)
<11	75
≥11	25

The results showed patients with total hypercholesterolemia, hyperLDLaemia, hypoHDLaemia, hypertriglyceridemia with percentages of 90, 67, 95 and 22 respectively compared to the total population.



**Fig. 1.** Distribution of the population according to dyslipidemia.

A statistically significant relationship between insulin and blood glucose (p-value < 0.05) with a negative correlation; was found.

GLYCEMIA (g/l)

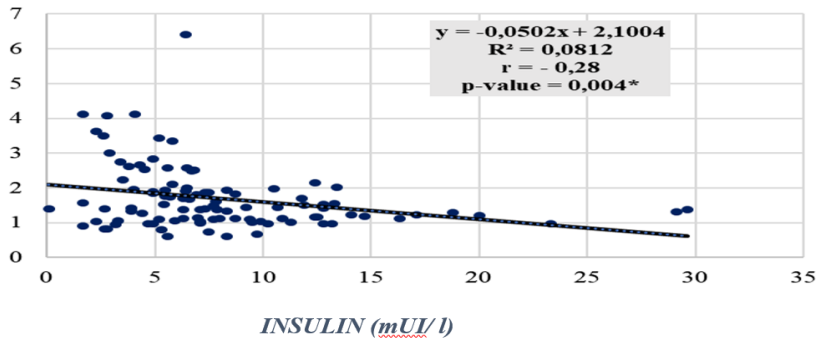


Fig. 2. Correlation curve between insulin and blood glucose levels.

No statistically significant relationship between insulin and total cholesterol (p-value > 0.05).

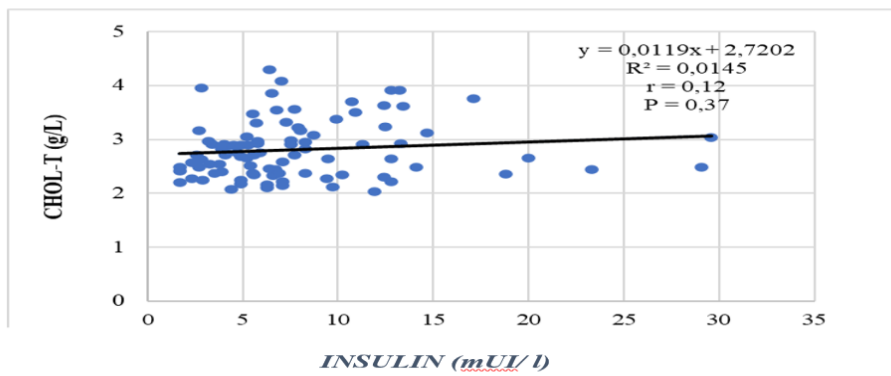


Fig. 3. Correlation curve between insulin and hypercholesterolemia.

Similarly, we found no statistically significant link between insulin and hyperLDLemia (p-value > 0.05).

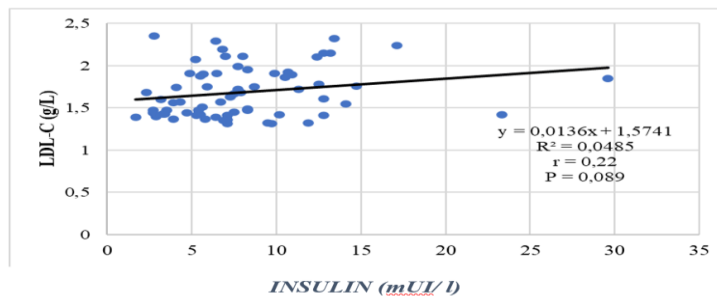


Fig. 4. Correlation curve between insulin and hyperLDLaemia.

No statistically significant association between insulin and hypertriglyceridemia (p-value >0.05).

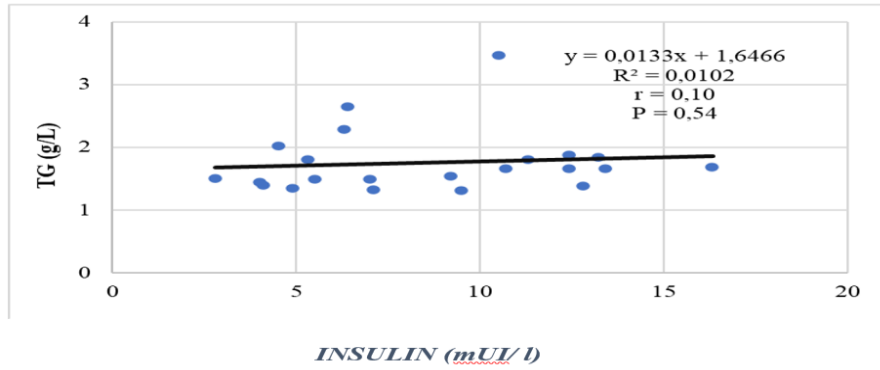


Fig. 5. Correlation curve between insulin and hypertriglyceridemia.

As for hypoHDLaemia, there was no statistically significant link with insulin (p value > 0.05).

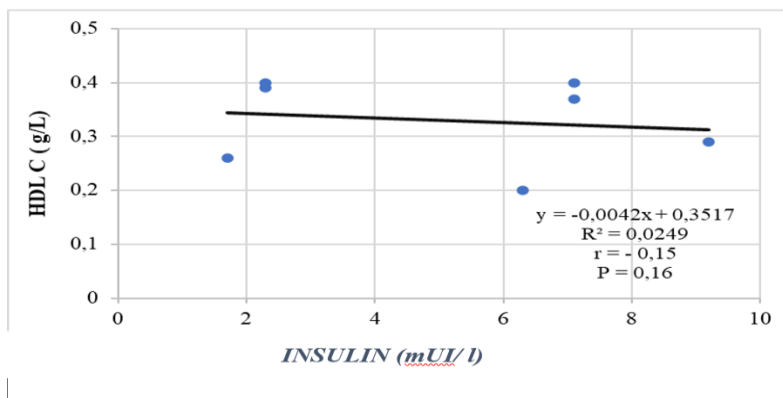


Fig. 6. Correlation curve between insulin and hypoHDLaemia.

#### 4. Discussion

Type 2 diabetes is a complex and heterogeneous progressive disease. It is characterized by high insulin resistance and a progressive decline in insulin secretion [7]. The association between insulin resistance and/or insulin secretion and anthropometric and metabolic parameters has been suggested by several authors [8]. It is with this in mind that we propose to carry out this study.

The risk of developing diabetes increases with age, and nowadays the age group most affected is the 40 to 59 age group [9]. Today, with our changing lifestyles (sedentary lifestyle) and eating habits, the incidence of type 2 diabetes is increasing in the younger population.

In our study, the average age was  $55.1 \pm 12.1$  years. The most represented age group was 55 or over, or 57%. Our results concur with those of DOUMBIA, who found 61.7% for an age range of 50 to 65 years, with an average of  $57.8 \pm 10$  years.

[10]. The results found in our study are superior to those of Maiga [11] found 50% for an age range of 45 to 59 years, or an average age of 48 years, and Cissé et al, who found an age range of 40 to 59 years, or 40.07%.

These results could be explained by the difference in age class: As age increases, so does the risk of type 2 diabetes. The correlation between age, dyslipidemia and diabetes has been confirmed by several authors [12].

Type 2 diabetes used to be mistakenly considered a disease of the elderly. Today, with changes in lifestyle (sedentary lifestyle) and eating habits, it is increasingly found in the younger population. We found a female predominance of type 2 diabetics, 61% versus 39% of men, with a sex ratio of 0.63. This result is close to that of Maiga A. and al [11] who found 67.6% for females, and that of Cissé with 58.6% [13]. This female predominance is confirmed by many American and European series and could be explained by a sedentary lifestyle, inactivity and hormonal influence. However, other studies, such as that by AMELLOUK SARA, have found a male predominance, with 57% men versus 43% women [14]. Dyslipidemias were found with 90% hypercholesterolemia, 35% hyperLDLaemia, 14% hypertriglyceridemia and 7% hypoHDLaemia. These percentages are higher than those of Cissé, who found hyperLDLaemia to be the most frequent dyslipidemia (31.19%), closely followed by hypercholesterolemia (30.89%). This predominance of hyperLDLaemia has also been reported in the work of Seck and Erem and al [15].

Regression analysis shows that insulin levels are obviously linked to blood glucose levels. Fasting serum insulin was negatively correlated with blood glucose in type 2 diabetic patients ( $r = -0.28$ ;  $p = 0.004$ ). This was found by Uddin and al. who showed an inverse correlation with the degree of hyperglycemia in type 2 diabetic subjects ( $r = -0.1867$ ;  $p = 0.037$ ) [9].

Indeed, chronic hyperglycemia in type 2 diabetes initially leads to a decrease in insulin secretion in response to glucose, and subsequently induces activation of the cell death process by apoptosis in pancreatic beta cells [16]. There was a statistically significant relationship between insulin and hypertriglyceridemia ( $p$ -value = 0.45) and between insulin and hyperLDLaemia ( $p$ -value = 0.010). These results are close to those of Surapon, who found a significant correlation between triglyceride levels and insulin resistance syndrome [17].

We also note a concordance with the results found by [M W Stewart](#), with a statically significant correlation between LDL cholesterol and insulin levels ( $P < 0.015$ ) and total triglyceride concentrations ( $P < 0.01$ ) [18]. All this information indicates that the diabetic state is associated with an atherogenic lipid disorder. Dyslipidemia is the result of both a deficit in insulin secretion and an insulin resistance characteristic of type 2 diabetes [14].

Fasting hypertriglyceridemia, which is particularly frequent in type 2 diabetics, is essentially due to an increase in large VLDL, with high production and reduced catabolism. This reduction in catabolism, associated with the increase in hepatic production, has been authenticated in vivo by kinetic studies [19].

## 5. Conclusion

Insulin resistance plays an important role in the pathophysiology of dyslipidemia in type 2 diabetes, which increases cardiovascular risk. Identifying and controlling lipid abnormalities is an important objective in preventing complications.

## REFERENCES

1. IDF Diabetes Atlas. [Online]. Available: <https://diabetesatlas.org/atlas/fifth-edition/>
2. Pessinaba S, Mbaye A, Yabéta GAD, et al. Enquête de prévalence des facteurs de risque cardiovasculaire en population générale à Saint-Louis (Sénégal). *Ann Cardiol Angéiologie*. 2013;62(4):253-258.
3. Mbaye MN, Diop SN, Sarr A, et al. mDiabète: le mobile au service de la lutte contre le diabète au Sénégal. *Médecine Mal Métaboliques*. 2015;9(2):143-6.
4. De Flines J, Laurent A, and Hennen G. Sugar diabetes. Update elements. *Rev Med Liege*. 1998;53(7):403-13. [PubMed](#)
5. Rapport\_annuel\_SD\_2017-18.pdf. [Online]. Available: [https://santediabete.org/wp-content/uploads/2019/09/Rapport\\_annuel\\_SD\\_2017-18.pdf](https://santediabete.org/wp-content/uploads/2019/09/Rapport_annuel_SD_2017-18.pdf)
6. Randoux C, Gillery P, Georges N, et al. Filtration of native and glycated  $\beta$ 2-microglobulin by charged and neutral dialysis membranes. *Kidney Int*. 2001;60(4):1571-1577. [PubMed](#) | [Crossref](#)
7. Ferrannini E. Insulin resistance versus insulin deficiency in non-insulin-dependent diabetes mellitus: Problems and prospects. *Endocr Rev*. 1998;19(4):477-490. [PubMed](#) | [Crossref](#)
8. Chang SA, Kim HS, Yoon KH, et al. Body mass index is the most important determining factor for the degree of insulin resistance in non-obese type 2 diabetic patients in Korea. *Metabolism*. 2004;53(2):142-146. [PubMed](#) | [Crossref](#)
9. [Online]. Available: <https://www.who.int/fr/news-room/fact-sheets/detail/diabetes>
10. Doumbia M. La dyslipidémie chez les patients diabétiques de type 2. 2018. [Online]. Available: <https://bibliosante.ml/bitstream/handle/123456789/13219/18P38.pdf?sequence=1&isAllowed=y>
11. Maiga A. Dépistage des facteurs de risque cardiovasculaires (dyslipidémies et hyperglycémie) au centre de santé de référence de la commune v et au chu gabriel toure. 2009. [Online]. Available: <https://bibliosante.ml/handle/123456789/9075>
12. Thiombiano LP, Mbaye A, Sarr SA, et al. Prévalence de la dyslipidémie dans la population rurale de Guéoul (Sénégal). *Ann Cardiol Angéiologie*. 2016;65(2):77-80. [PubMed](#) | [Crossref](#)
13. Ousmane C, Mohamed DS, Fatoumata B, et al. Le profil lipidique et glucidique des accidents vasculaires cérébraux ischémiques à Dakar. *Pan Afr Med J*. 2016;25:29. [Online]. Available: <http://www.panafrican-med-journal.com/content/article/25/29/full/>
14. [Online]. Available: [https://cdim.fmp-usmba.ac.ma/mediatheque/e\\_theses/157-19.pdf](https://cdim.fmp-usmba.ac.ma/mediatheque/e_theses/157-19.pdf)
15. Seck SM, Doupa D, Ahou S, et al. Prevalence and associated factors of diabetic kidney disease in senegalese patients: A cross-sectional study in Saint-Louis. *Open J Nephrol*. 2020;10(01):23-33.

16. Abdesselem H, Sebai I, Jemal M, et al. Étude de la corrélation entre la sensibilité à l'insuline et les paramètres anthropométriques et métaboliques dans le diabète de type 2. *Ann Cardiol Angéiologie*. 2018;67(3):167-73.
17. Tangvarasittichai S, Poonsub P, and Tangvarasittichai O. Association of serum lipoprotein ratios with insulin resistance in type 2 diabetes mellitus. *Indian J Med Res*. 2010;131:641-648. [PubMed](#)
18. Stewart MW, Laker MF, Dyer RG, et al. Lipoprotein compositional abnormalities and insulin resistance in type II diabetic patients with mild hyperlipidemia. *Arterioscler Thromb J Vasc Biol*. 1993;13(7):1046-1052. [PubMed](#) | [Crossref](#)
19. Duvillard L, Pont F, Florentin E, et al. Metabolic abnormalities of apolipoprotein B-containing lipoproteins in non-insulin-dependent diabetes: A stable isotope kinetic study. *Eur J Clin Invest*. 2000;30(8):685-694. [PubMed](#) | [Crossref](#)

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